

The genesis of cave symbols

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Cave symbols are important to denote cave details in a simple and concise way. Symbols allow to make cave maps compassing lot of information in a limited space. The standardization of the symbology makes cave maps understandable by any caver, apart from text annotations. On the other hand it is impossible to have a set including symbols for all the details that may appear in a cave map. Therefore any set of cave symbols will never cover all the needs of the map drafter, and this will need to come up with custom-made symbols or pictorial representations. Furthermore a cave map is only part of the cave documentation and must be completed by textual description, pictures, and audio and video documentation.

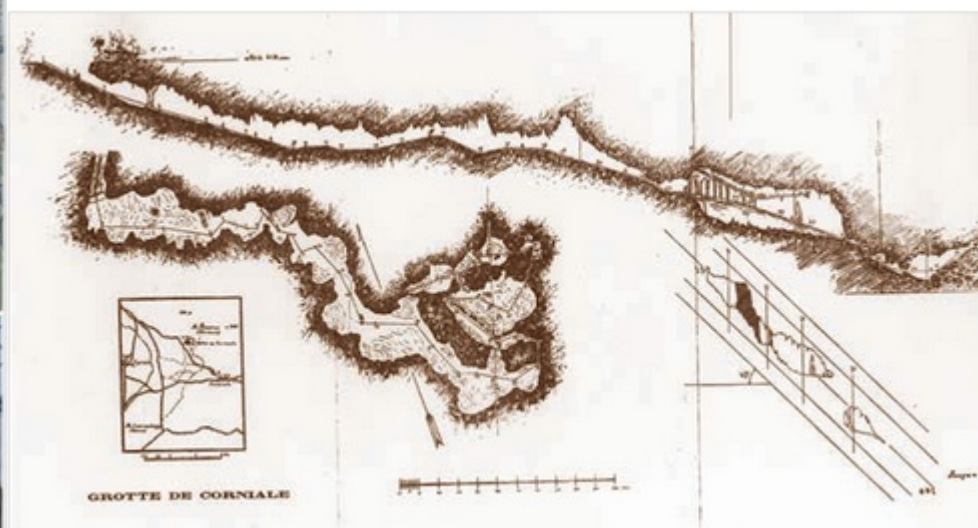
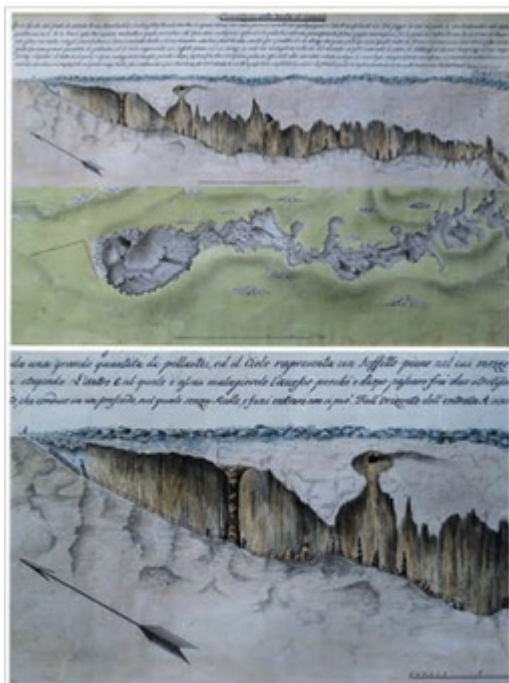
This note reviews the development of the cave map symbols, among the speleological societies in some european and north america countries, and, later, inside the Union Internationale de Speleologie.



Map of 1723 (Gyorgy)

The first known "cave" maps are maps of artificial cavities: a 1415 map of the Labyrinth of Gortyne (Crete) by C. Buondelmonti [47], and a 1564 map of the Stufe di Nerone (Italy) [45]. The first maps of natural caves are a 1651 map of St. Rosalia cave (Italy) [44], a 1656 drawing of the Baumannshoehle (Germany) [9, 36], and a survey of Pen Park Hole published by the Royal Society in 1682 [31]. Cave started to be represented in maps from the end of the 16-th century. Initially the maps were rather fantastics, mixing physical and imaginary entities. These maps are drawings of the author view and perception of the cave, which is represented pictorially. In Australia the first known cave maps are from 1827 and 1832 [39].

In the 18-th century the maps of caves started to have more details, although they remained pictorial. The cave surveyors began to add informations related to their studies of caves: blocks, clay, water, formations, beddings, and so on [46].



Above: cave survey by E. Boegan (1897)
Left: cave survey by Vincentini (1818)

The first use of a cave symbology appears in the maps drawn by Jannet e Racovitza [2] in the reports of their biospeleological searches. Only the plan view is considered as this was sufficient for their documentation needs. In some cases the plan view is integrated by cross sections. The symbology is introduced as shorthand for the most common annotations that come with the survey. It is quite detailed and has circled letters for special notes (eg. "CS" for bat), graphics and icons:

- The need for standard cave symbols arose already when, during the first world war, the AustroHungarich govern decided to use the phosphor deposits of the caves as fertilizer for agriculture. Over 1500 caves were explored and surveyed. However it become apparent that the organization of an industrial exploitation of the resources required a uniform symbology.

The symbols of Teissl (1925) [3] include

- Entrée de grotte horizontale (a) et verticale (puits, aven) (b).

Région à pierres plates reposant sur l'argile.

Limite de pénétration de la lumière du jour.

Racines : Y
Gaïon : X
Débris végétaux #

Pente dont l'allure est représentée par des courbes de niveaux, la direction descendante par des flèches et la dénivellation par le nombre de mètres.

Parois nues (a); couvertes d'enduit stalagmitique (b); incrustées de concrétions variées (r) et très fortement incrustées (d).

Filles : •••
Bornes : ○ ○
Massifs stalagmitiques isolés (a) et soudés aux parois (b).

Température de l'endroit en degrés centigrades, pour l'air et pour l'eau.

Coulées stalagmitiques anguleuses ou de tuil.

Cheminées du plafond (a) et puits ou avens du plancher (b).

Gours vides (a) et pleins d'eau (b).

Éboulis formés par de gros rochers ou de grands pierres.

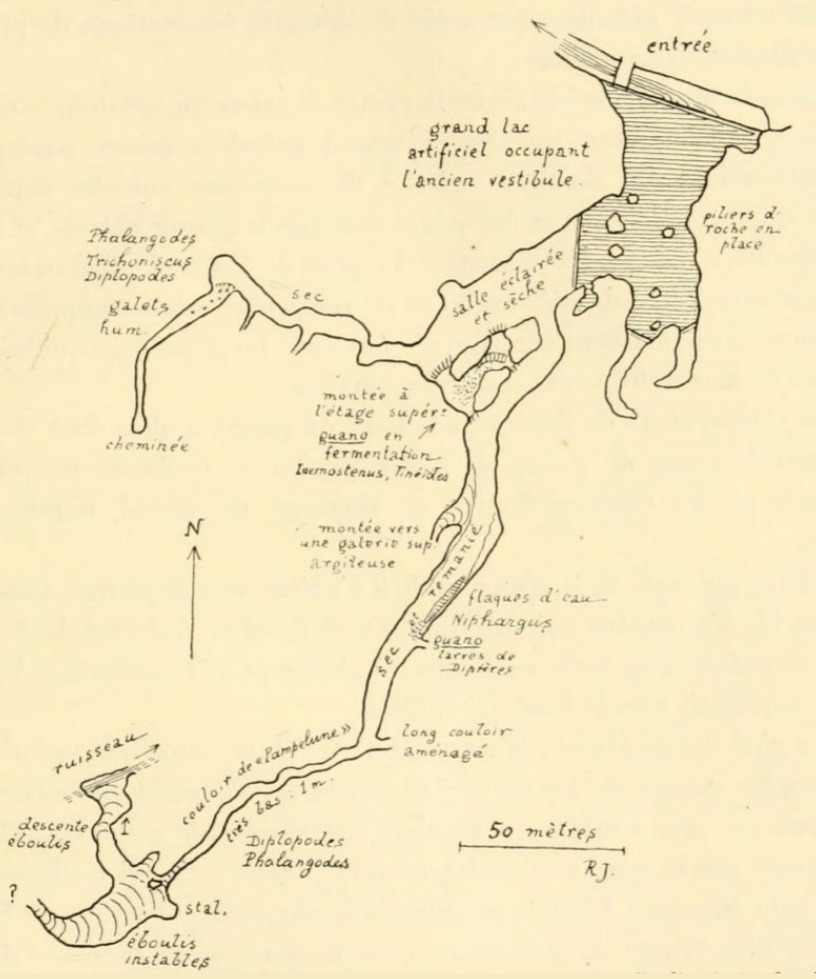
Bassins aquifères divers autres que les gours.

Argiles : A
Sables : S
GRAVIERES : G

Eaux courantes : le sens de l'écoulement est indiqué par une flèche de forme spéciale.

Annotations topographiques et relatives aux objets inanimés : En caractères droits, genre imprimerie ; exemple : Salle des vasques Éboullis.
Noms de Biotés : En caractères penchés manuscrits ; exemple : Trichomiscus.
Gîtes restreints de Biotés : Une lettre de renvoi encadrée ; exemple : ① = Trichomiscus, ② = Leptoneta.
Signes spéciaux invariables : (CS) = Chauves-Souris, (X) = Troglodytes nombreux et variés.

Jannet-Racovitza symbols (1918)

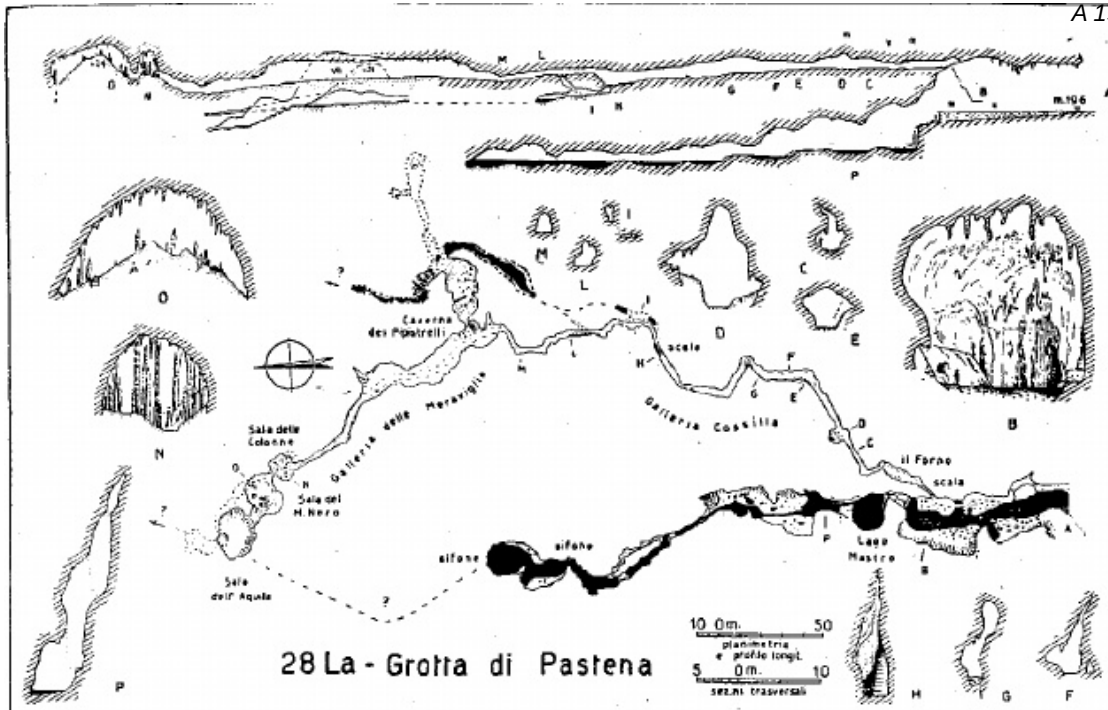


Until the Second World War, and for several years after it, the cave maps remained "drawings", representations of the author's view of the cave and of his drafting ability. The image on the next page is a map published in 1948. It is just an example of the way cave maps were produced. The general characteristics are the hatch around the cave walls, the formations drawn pictorially, the water (filled area), the clay (dotted area), and the continuations (question mark).

Many caving groups were founded after the Second World War. Every group developed a proper cave symbology and representation style, without a shared approach. There were several obstacles to the definition and diffusion of a common symbology. Most of the groups operated in a restricted area, due to the difficulties to travel. The survey was motivated only by the local necessity to document the caves for the group activity. To these we must add the inertia to change the way of drafting maps, and the fact that very few details were

Höhlenzeichenschlüssel.

Für		Zeichen	Für		Zeichen	Für		Zeichen
Vermessungspunkte	Anbinde-(Stütz-) Punkt	△ E	Bodenbeschaffenheit	Schächte	☼	Kommunikationen	Führerweg	— — — — —
	Polygonpunkt	○ III		Eis (geschlossene Formenlinien)	☉		projektierte Wegtrasse	=====
	Höhenmarke an der Tagöffnung	— H.M.		Sondereisformen (Eiskuchen; schleier; keulen; tische etc)	☾ S		gebauter Weg	=====
	Höhenkote	± 953		Bach	~~~~~		Versicherungsdrahtseil mit Mauerhacken	— — — — —
Bodenbeschaffenheit	Sand	☼ S		Wasserfall	~~~~~		Brücke aus Eisen	— — — — —
	Lehm	☼ L		Tropfwasser	☼ T.W.		Brücke aus Holz	— — — — —
	Guano	☼ G		Wassertümpel	☼ W.T.		Leiter	— — — — —
	Knochenerde	☼		Quelle	☼		Gefährliche Kletterstellen	☼
	Schotterbank	☼		Sinterterrassen u. Becken	☼		mit Vorsicht zu begehen	☼
	Schotter vereinzelt	☼		Sintervorhang	☼		nur mit techn. Hilfen zu be- steigen im Aufstieg	☼
	Felstrümmen u. Blockhalden	☼		Sinterboden (über die ganze Sinterfläche)	☼		im Abstieg	☼
	~ detto ~ auf Skizzen (offen in der Richtung der Steigung)	☼		Riesentropfstein	☼		Probegrube und Schlitz	☼ P.G.
	Plattenschüsse	☼	Wand- u. Deckenbeschaffenheit	Säule	☼	Diverse andere Zeichen	Sohlengefälle (wenn ohne Schichtenlinien)	→
	Tonplatten	☼		Schloten und Kamine	☼		Windrichtung (Federung nach der Stärke)	→
	Rinnenbildung, wenn ohne Schichten- linien	☼		nackt	☼		Schichtenlinien (die „Hunderter“ verstärken)	→
	~ detto ~ mit „	☼		überzogen	☼		Photographischer Aufnahmezustand (offen in der Richtung der Aufnahme)	☼
	Abgründe und Abstürze	☼		inkrustiert	☼		Fundstellen	☼
	Trichter	☼		abwechselnd nackt und überzogen	☼		Flora	☼
							Fauna	☼
							prähistorische Fundorte	☼



necessary for the publication of small scale maps of major caves (usually composed just of the contour lines).

Nevertheless, with the diffusion of speleology, and the development of international relations, the necessity of a common language for cave maps became apparent.

Boegli devised in 1952 for the exploration of the Holloch cave and used by AGH (Arbeitsgemeinschaft Hollochforschung) a set of symbols similar to those of Teissl:

- stations (triangle or point), altitude (circle with four legs and value), slope (arrow and value in degrees)
- pits (ticked line with depth in meters), and chimneys ('+')
- hydrology: pools (single dash) and sumps (double dash), flows (wavy arrow, temporary and permanent flows are distinguished), sources and sinks
- underlying gallery, cross-section lines
- geology: bedding dip, faults, scallops and plunge pools
- cave walls (lines with hatch on the side of the bedrock)
- formations: symbolic icons for stalactites, stalagmites, columns, flowstone, helictites, moonmilk, crystals (calcite or gypsum)
- deposits: blocks, gravel, clay
- air flow (dashed arrow)

Boegli symbology is reported by Trimmel-Audetat [21].

SIGNES CONVENTIONNELS SYSTEME DR. A. BOEGLI

Grands réseaux, plans à petite échelle

1. Station topo. principale



2. Station topo. secondaire



3. Ligne de visée



4. Diaclase



5. Vague d'érosion



6. Concrétions



7. Stalactite



8. Stalagmite



9. Glace (avec date)



10. Arrivée d'eau

11. Cours d'eau (avec direction)

12. Point d'absorption, perte

13. Lac, bassin (avec partie sous voûte mouillante)

14. Voûte mouillante

15. Cascade

16. Argile

17. Sable

18. Gravier, galets

19. Blocs de rochers

20. Puits



21. Cheminée



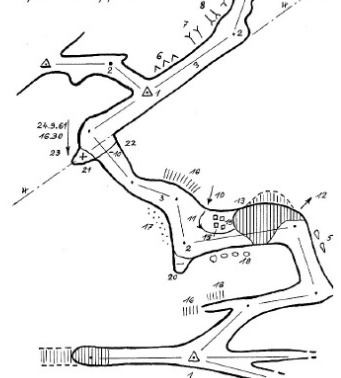
22. Dénivellation, ressaut



23. Courant d'air (date et heure)



Exemple d'application



A commission for speleological terms and symbols was created during the first International Congress of Speleology (Paris, 1953), with the aim to uniformize the presentations of caves, and thus making easier the exchange of information [Trimmel-1966]. The work of the commission went on for several years. In the third congress (Wien, 1961) the proposal of Boegli for cave symbols for small scale maps (1:500, 1:1000 and smaller) was accepted. The symbols were drawn on the side of the cave outline according to the system created by Boegli in 1952 [22, 23].

At the same time Fink (1963) prepared a comparison of the symbols used in different nations (France, Italy, Swiss, Austria, Yugoslavia, USA) and a proposal for unification [24]. The two symbol sets were later confirmed in the next Congress (Ljubljana, 1965) together with symbols for karst surface features (adapted from BRGM, Bureaux des Recherches Géologiques et Minières).

These symbols sets are published in Trimmel-Audetat (1966) [21]. A comparison between small scale and large scale symbols is also in the book by Boegli (1978) [30].

The small scale symbol set includes

- stations (triangle or point), midline (polyline broken at the stations)
- formations, stalactites, stalagmites
- hydrology: flow, spring, sink, pool (hatch) and sump, waterfall (a line crossing the lines of water flow)
- deposits: clay (slanted dashes), sand (points), gravel, blocks, ice (with the date)
- drop (thin line with height)
- air flow (arrow with the date)
- pit ('-'), chimney ('+')
- diacalse (dashed line)
- scallop

SIGNES CONVENTIONNELS POUR PLANS DE GROTTES.		8. Dénivellation par rapport à l'orifice (orifice principal)		18. Gouffre-cheminée	
Plans de grottes à grande échelle.		9. Emplacement d'une coupe transvers.		19. Blocs de rochers	
Système présenté par M.H. FINK. (Wien)		10. Galerie		20. Eboulis	
1. Stations topographiques :		11. Galerie passant au-dessous d'une autre		21. Galets	
Station topo. principale		12. Galerie secondaire passant au-dessus d'une galerie principale		22. Argiles, sables et sédiments	
Station topo. secondaire		11/12 Superposition de trois galeries		23. Stalagmites	
2. Lignes de visée		13. Continuation inconnue		24. Stalactites	
3. Altitude (au-dessus de la mer)		14. Dénivellation brutale		25. Colonne	
4. Isohypses (Courbe de niveau)		15. Gouffre, puits intérieur		26. Gours	
5. Reliefs du sol, (la flèche indique le point le plus bas).		16. Gouffre ou puits en surface		27. Plancher stalagmitique	
6. Inclinaison du sol, pente (la flèche indique le point le plus bas)		17. Cheminée		28. Coulee stalagmitique, concrétion	
7. Hauteur de la voûte (à l'endroit indiqué par le signe).					
29. Mondmilch, lait de lune		40. Suintements			
30. Cristallisations		41. Neige et glace			
31. Concrétions excentriques		42. Situation des strates			
32. Cours d'eau souterrain		A horizontales			
33. Arrivée d'eau dans une galerie		B peu inclinées			
Perte		C fortement inclinées			
34. Perte à travers argiles, sables etc.		D verticales			
35. Rivière souterraine		43. Diacalse, fissure			
36. Chute, cascade		44. Faille, décrochement			
37. Siphon					
38. Rivière souterraine temporaire					
39. Lac souterrain, bassin					

The large-scale symbology includes:

- stations (triangle or dot), midline (dashed segments)
- altitudes (as in Boegli), level lines (with slope arrow and altitude)
- slopes (arrow with slope degrees)
- ceiling height (value in a circle), depth (with respect to the entrance)
- cross-section lines
- underlying passages, possible continuation (question mark, '?')
- drops (with height), pits (with depth), chimneys (plus sign '+')
- clay/sand, gravel, blocks, and snow/ice (dashes)
- stalagmites (filled circle), stalactites (empty circle), column (filled circle inside empty circle), formations, flowstone (dashes) and wall-flowstone (thick fills), moonmilk, crystals (asterisc), helictite
- water flow, spring and sink, water-fall

Blatt ②	II., RAUMDARSTELLUNG						
	FRANKREICH	ITALIEN	JUGOSLAWIEN	ÖSTERREICH	SCHWEIZ	U. S. A.	VORSCHLAG:
11 Raumbegrenzung, unterlagernder Höhlengang	##	##	##	##	##	##	##
12 Überlagernder Höhlengang				##	##		##
13 unerforscht	== ?		== ?	== ?		== ?	== ?
14 nicht vermessen	==	==	==	==		==	==
15 unbefahrbar						==	==
16 Steilabbruch, Wandstufe	///	///	///	///	///	///	///
17 Innenschacht	○	○	○	○	○	○	○
18 Außenschacht	○	○	○	○	○	○	○
19 Schlot	○	○	○	○	○	○	○
20 Schacht u. Schlot	○	○	○	○	○	○	○

Blatt ③	III., SEDIMENTE UND KRISTALLISATIONEN						
	FRANKREICH	ITALIEN	JUGOSLAWIEN	ÖSTERREICH	SCHWEIZ	U. S. A.	VORSCHLAG:
21 Blockwerk und Brechschutt	Δ Δ	Δ Δ	Δ Δ	Δ Δ	Δ Δ	Δ Δ	Δ Δ
22 Geschiebe, Schotter	○ ○	○ ○	○ ○	○ ○	○ ○	○ ○	○ ○
23 Kühlturm	==	==	==	==	==	==	==
24 Sand	==	==	==	==	==	==	==
25 erdige Sedimente	==	==	==	==	==	==	==
26 Guano	X X	X X	X X	X X	X X	X X	X X
27 Stalagmit	○	○	○	○	○	○	○
28 Stalaktit	○	○	○	○	○	○	○
29 Tropfsteinkule	○	○	○	○	○	○	○
30 Sinterbecken	○	○	○	○	○	○	○
31 Bodenversinterung	==	==	==	==	==	==	==
32 Wandversinterung	==	==	==	==	==	==	==
33 Bergmilch	○	○	○	○	○	○	○
34 Kristalle	○	○	○	○	○	○	○
35 Excentriques	○	○	○	○	○	○	○

Two comparison tables of the cave symbols, by Fink (1963)

Several publications containing a speleological symbology appeared during the years before the Wien Congress, and those between this and the Ljubljana Congress. In general there are many similarities, like the use of dashed lines for uncertain cave walls, and for the underlying gallery, ticks or triangles to denote the pit and the chimney. However they differed in the details. The symbols for the cave fillings is rather uniform, being these represented pictorially. The symbols for formations vary from pictographic forms to stylish icons. For the hydrology there is a tendency to draw the water flows with parallel lines and an arrow indicating the direction of flow. A special importance is attached to waterfalls and sumps. The air flow is always shown with an arrow, but the styles differ.

Burkhardt et al. (1951) [5] includes symbols for both the plan view and the profile view: stations (triangles), altitude [points], midline, North symbol, cave wall (a simple line in the plan, a line with external hatch in the profile), underlying galleries (dashed line), cross-sections, pits (line with triangles), level lines and slopes (line with ticks), chimneys ('+'), formations: stalactites and stalagmites (circle in the plan, pictorial in the profile), deposits (clay, sand, blocks), artifacts.

—	ἡ γραμμή τοιχώματος—Limite de la caverne—Limit	5	Βάθος ὕδατος—Profondeur d'eau—Depth of water
---	Συνέχεια γραμμῆς τοιχώματος εἰς ἀνώτερον ἐπίπεδον—Suite d'une ligne limite à un plan élevé—Suit of limit line in a higher plan	---	Νερά, πάγος—Eau, glace—Water, ice
.....	Γραμμή ἡ δρομῆς—Ligne du plafond—line of ceiling	→	ῥέοντα ὕδατα—Eau courante—Running water
⊙ ⊙	Βράχοι, γραμμὴ ἀλλαγῆς κλίσεων—Roches, lignes de changement des pentes—Rocks, slope of the floor	→	ῥέοντα ὕδατα ὁρμητικὰ—Eau courante torrentielle—Running water quickly
○	Στήλοι—Piliers—Pillars	>	Κόλπη ξηρὰ—Fhalweg sec—Dry thalweg
☀	Αὐλάκι, βότρυς—Fosse, depression—Hollers	⊙	Διὸν—Tourbillon—Turning water
⊙	Πηγάδι—Puits—Pits	⇒	Καταρράκτης—Cascade—
⊙	Χημνός—Cheminées—Chimneys	☀	Σταλακτιτὶ καὶ—Matière stalagmitique—Gout—Terraced stalagmit
5	ὕψος δρομῆς—Hauteur du plafond—Height of the ceiling	☀	ῥέοντα ὕδατα—Matière granulée, sable, terre, guano—Sand, clay, guano
4	Βάθος, ὅταν τὸ σημεῖον καίται χαμηλότερον τῆς εἰσόδου—Profondeur, quand le point est plus bas que l'entrée—Depth, when the point is lower than the entrance	X	ὀστά—Os—Bones
4	Βάθος, ὅταν τὸ σημεῖον καίται ὑψηλότερον τῆς εἰσόδου—Profondeur, quand le point est plus haut que l'entrée—Depth, when the point is higher than the entrance	X	Βόλα—Bois—Wood
+		X	Κλίσις στρωμάτων—Pente des couches—Dip of strata
		X	Κατακόρυφοι στρώσεις—Couches verticaux—Vertical strata
		X	Ὁριζόντιοι στρώσεις—Couches horizontaux—Horizontal strata

Symbols from the Bulletin of the Hellenic Speleological Society (1951)

The same year the Bulletin of the Hellenic Speleological Society published a two-page list of symbols for cave surveys [6]. These include a distinction among walls, underlying and overpassing passages, and symbols for pits, chimneys, level curves, hydrology (waterflows, falls, pool), dimensions, flowstone line, deposits (a single symbol for pebbles, sand, clay, mud, guano), findings (bone, wood), and geology (direction and dip of strata).

Butcher (1953) [7] has symbols for only the plan view: stations (triangle, or circle with dot at the center), ceiling height, pool depth, entrance, daylight limit, pit, chimney, underlying passage, continuation, slopes and depths, deposits (blocks, gravels, sand, clay), formations (stalactites, stalagmites, column, flowstone), roots, guano, vegetable debris, a detailed symbology for hydrology (pool, flow, sump), air flow, and geological symbols. This symbology is reported also in Butcher (1966) and Cullingford (1969).

These same symbols are listed in the appendix of Acta Carsologica (1955) [8], where the cave wall line has also an external hatch is used to denote the rock. There are also symbols for snow, ice, air temperature, symbols for fossils, paleontological and archeological findings.

In Italy Rondina was appointed by the Italian Spelological Society to research about the cave map symbols in use, and he found that most draftsmen followed their own style. In 1955 (VII Nat. Congress) a commission was created with the aim to define a conventional cave map symbology. In 1958 a proposal for a detailed cave symbology was produced. It comprised both surface and underground symbols [10]. The latter included: morphology (chimney, underlying gallery, continuation), hydrology (ponds are

PLASTICA IPOGEA			IDROGRAFIA		
1		Linee di andamento del suolo con indicaz. pendenza verso il basso	1		Sorgente
2		Pozzo	2		Forte stillicidio
3		Camino inesplorato	3		Acqua corrente - Torrente
4		Presupposto proseguimento	4		Bacino chiuso - Lago
5		Calotte	5		Acqua corrente con tratto non a pelo libero - Sifone
6		Frana	6		Laghetto con tratto non a pelo libero
7		Rami di grotta sottostanti i rami superiori principali	7		Cascata
8		Rami di grotta soprastanti i rami inferiori principali	8		Tragitto presupposto di corso d'acqua
9		Rami di grotta retrostanti i rami principali sezionati	9		Corso d'acqua talvolta asciutto
10		a-Sentiero b-Sentiero battuto con fondo artif.	10		Ghiaccio
11		Scale a pioli fissa	11		Laghetto con livello incostante
12		Scalinata artificiale in pietra, legno, calcestruzzo	12		Profondità acque non marine
13		Ponte in legno o ferro	13		Profondità acque marine
14		Muro di sostegno	14		Sorgente termale
15		Limite di penetrazione della luce	DEPOSITI		
16		Limite super. dello sbocco della grotta	1		Massi franati
17		Altezza della volta	2		Ciottoli arrotondati
CONCREZIONI			3		Terrecchio (comunemente : terra)
1		Colata o crostone stalagmitico	4		Sabbia
2		Concrezioni alle pareti	5		Argilla
3		Concrezioni alle pareti con sottostante colata stalagmitica	6		Terra, sabbia, argilla con ciottoli
4		Concrezioni a vaschetta asciutte	7		Detriti minuti
5		Concrezioni a vaschetta con acqua	8		Ossa in sabbia e argilla
6		Colonna stalatto-stalagmitica	9		Guano
7		Stalattiti isolate	10		Humus
8		Stalattiti	11		Ghiaia
9		Cortina stalattitica			

shown as filled area, but the water flow is missing), formations (stalactites, stalagmites, columns; all represented pictorially), deposits (blocks, gravel, sand, clay, guano, snow, ice), geological symbols (bedding dip, fault, lithologies), findings, meteorology (air flow and temperature), and other symbols (scalebar, north arrow, etc.)

Anker and Joller (1959) [12] has a long list of symbols (for the plan, the profile and the cross-sections) which includes stations, pits (with the depth value), chimneys (with height), underlying passages, deposits (blocks, gravels, clay, sand, ice), formations (including column, helictite, flowstone, moonmilk, gour, crystals), ceiling meander and floor meander, air flow and a very detailed hydrology. This symbology is based on that of Boegli (1956), on discussions inside the OGH (Ostschweizerischen Gesellschaft für Höhlenforschung), the symbols of Charles H. Roth (1942), those in *Acta Carsologica*, and discussions with English surveyors. The symbology of Anker and Joller was proposed at the 2-nd Int. Congr. of Speleology in Bari, where it was also discussed that of Rondina (with minor revisions) [13].

Petrochilos (1959) [15] presents a symbology similar to that of Rondina [10]. There are variations however in the symbols for the cave morphology (distinct dashing of overpassing and underlying passages, differences for pits and chimneys, etc.), the hydrology (lighter water hatch), and deposits (clay and guano). It has also a symbology for denoting the vertical dimensions that is almost excessive.

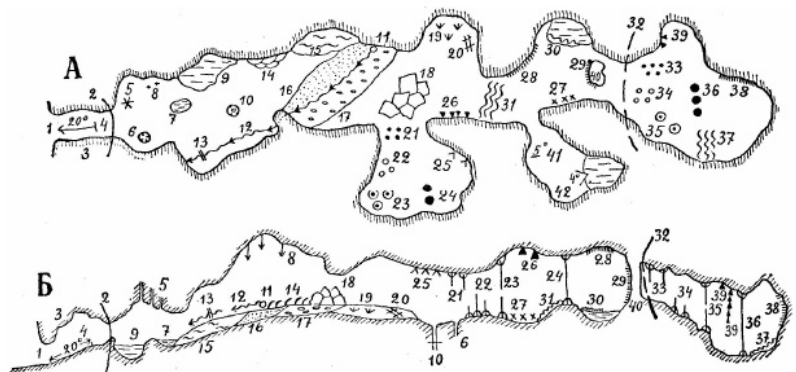
The NSS Bulletin contained a proposal about cave symbols already in 1944 [4]. Later a discussion for a standard symbology started in 1961 with a draft by Will White et al. [16]. This symbology includes differences to distinguish chokes from continuations, the underlying galleries from the unsurveyed ones. There are pits, chimneys, slopes, dimensions, deposits (clay, sand, gravels, guano, stones, blocks, mud, ice), formations (stalactites, stalagmites, column, helictite, drapery, flowstone), ceiling meander, scallop, hydrology (flow, pool, waterfall, sump), stations and artifacts. The work continued for many years (see [20, 28]).

Vineyard (1962) [17] has symbols for the underlying galleries, unexplored continuations, height, depth, gradient, formations (stalactite, stalagmites, column, gour, flowstone), slopes, pits, chimneys, ceiling meander and floor meander, hydrology, deposits (blocks, stones, gravel, sand), and artifacts. This work extends the symbology of Deike R. (1959 *Missouri Speleology* 1(3) p. 22) and cites Butcher (1950) [7].

Максимович (1963) [18] presents a stylish symbology (figure below). Hydrology: pool (hatch) and flow (weavy arrow). Formations: stalactites and stalagmites ('Y' in the profile, a circle in the plan), flowstone, etc. Gradient (arrow) and deposits (sand, clay, gravel blocks). Besides his own works the author cites Anker [12], Butcher [7], Petrochilos [15], and [14].

Ariagno (1965) [19] reports a few symbols appeared on *Spelunca* (Dic. 1962). They are essentially similar to those of Boegli: deposits (sand, clay, gravels, blocks, ice - with the date), air flow, hydrology: pool (hatch) and flows (weavy arrow), springs and sinks, pits, chimneys, stylish formations (stalactites, stalagmites and flowstone).

The Association for Mexican Cave Studies [20] adopted a cave symbology that includes unsurveyed and under/over-passing passages, stations, dimensions (height and depth), cross section, slope, drop, pit and dome (in feet), deposits (guano, crystalline, sand, clay, gravel, blocks), formations (stalactite, stalagmite, column, flowstone, rimstone dam, soda straws), waterflow, pool, sump, geology (strike, dip, fault), and artifacts.



Cave symbols, Максимович (1963)

Bini and Cappa (1974) [26] published a proposal for conventional symbols that aimed to be complete, scale adaptable, intuitive, simple, and in agreement with symbols for karstic areas and geological and hydrological symbols. The symbols are organized by categories: morphology, tectonics, deposits, formations, erosion forms, hydrology, and miscellanea. This symbology is excessively detailed, with many semantical variations tied to small graphical differences. It remains nevertheless incomplete, as any symbology (for example it lacks a symbol for "root").

In 1965, when UIS was founded, a commission was created for the speleological terminology and conventional symbols. Trimmel, who had already collected some documentation about the symbologies used in different countries, proposed to subdivide the work in four tasks: surface symbols, long cave symbols, small cave symbols, and terminology (Proc.4-th ICS, 1965). In 1969 the commission was split in two commissions, one for the symbols and the other for the terminology. In 1977 the two commissions were again joined in a single one. In 1978 UIS published the first standard symbol set [29].

In the same years the commission for the speleological symbols of NSS (J. Hedges et al., 1979) [31] produced a symbology, after having carefully considered and discussed what has been created or

proposed in several countries (see for example [25]). This symbol set is basically still in use in USA (Dasher 1994) [35]. It is still very rich, without the excess of details of Bini-Cappa. There are more than 150 symbols, but it has a reduced set of symbols with only the most important ones (although it does not include the air flow):

- station, altitude (relative to the datum), ceiling height, cross-section
- wall, presumed wall, underlying gallery, pit, chimney, step, ceiling step, slope
- formations: stalactite, stalagmite, column, soda-straw, flowstone, gour
- deposits: blocks, stones, gravel, sand, clay, and a symbol for the rock
- water: pool, flow

In 1995, at the Second Meeting of Underground Topography (Breitenbach ch), the speleological symbols in use in the different countries went under discussion and it was proposed a review of the 1978 symbology [33]. The proposal was discussed in the UIS Congress at Chaux de Fonds (1997), and later through email exchange. Finally the definite list of symbols was voted and accepted by the national delegates on 16 ottobre 1998 [34, 37]. The UIS symbol set went under revision in 2008 but remained unchanged. [43, 52]

The list of UIS speleological symbols is not exhaustive. It provides only a minimal common set of symbols. National speleological organization and surveyors can add other symbols that may be necessary (a symbol legend should be included in the cave map). The UIS symbology not only provides the graphical form of the symbols but it also describes how each symbol should be used. Furthermore it stresses the importance of the textual description of the cave as completion of the cave map.

Being twenty years since its definition, we can confidently say that the UIS symbology is accepted worldwide, at least formally. Its adoption in the practice of cave surveying is still unsatisfactory. A reason

	Plan	Section		Plan	Section		Plan	Section
Main Measuring Points			Dripline (beginning of the cave) - Profile (arrow in line of view)			Difference in Elevation (height in meters) - Joint - Fault - Inclined Joint		
Outline of a gallery			Step (height in meters)			Lake Flowing Water		
Underlying galleries			Pit (depth in meters)			Sump		
Too narrow continuation			Pit open to the surface			Cascade Waterfall		
Continuation possible			Chimney - Chimney-Pit			Spring - Sink		
Presumed dimensions of Space			Contourlines (altitude in meters) - Gradient arrows Entrance arrow			Widespread Water Inlet - Seeping		
Ceiling form			Gradient Lines Altitude above Sealevel			Scallops - Flutes in general - Direction of paleoflow		
	Plan	Section		Plan	Section		Plan	Section
Air Draught (with date in dd.mm.yyyy format) - Ice-Snow-Firn			North Arrow - Geographic - Cartesic and Magnetic			Anostomosen - Karren		
Stalagmites			Blocks - Debris			Caulflowercalcite - Disk		
Stalactites			Pebbles			Bones		
Sinter Curtains Pillars			Clastic sediments - Sand-Silt-Clay-Humus			Human Activity (artwork, drawing, pottery, old mining sites, human bones, ...)		
Helictites - Soda Straws - Crystals			Claycovered Walls			Height of a room (height in meters)		
Sinter Pools			Guano					
Flowstone - Wall Calcite - Moonmilk			Camp					

may be the fact that few cave surveying books have been written after its final release (an example is Day 2002 [38]), and the surveying courses still use old textbooks (indeed "good" textbooks; the problem is not the book but the teacher who do not update). Furthermore, even recent books may be biased towards national usage, and present symbols that are more common locally, rather than UIS symbols. Finally the instructors of surveying courses often use, in their classes, symbology from old publications, maybe because these are more detailed (examples non included for the sake of fellow cavers). A strong push to the adoption of UIS symbology is coming from the cave map drawing programs. As these include the official UIS symbols, the user is driven to use it. However the UIS symbology is not complete (by design) and these program has additional symbols. Therion includes three or four other national symbology besides the UIS one. CSurvey has the UIS symbols, as well as many other graphics. CaveInk, a plugin for Illustrator/Inkscape, has the UIS symbols and several others (not alternative to UIS).

In 2006 the informatics commission of UIS has adopted a symbology for karst surface features [41, 42]. In 2013 the work started towards a proposal for artificial cavities symbols. The discussion was continued at the 2015 International Congress of Artificial Cavities, in Rome [49]. In the following a symbology was drafted and was to be voted in 2017 or 2018 [50, 51].

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